Forecasting climate impacts on wildlife of the arid southwest at regional and local scales using downscaled climate models

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Climate change has emerged as a key environmental concern of the 21st century and a major challenge for land and wildlife managers. Although scientists have made tremendous progress in predicting the impact of climate change on a regional and global scale, drilling down such projections to a locally applicable form has been difficult. A major project of the USGS Southwest Biological Science Center (SBSC), funded by the USGS National Climate Change and Wildlife Science Center, will draw on the work of an interdisciplinary team of scientists to help close the gap between theory and practical application in the arid southwestern U.S.

This part of the country is of particular interest for multiple reasons. Climate change in this region is predicted to be extreme, with temperature increases within the next 60 to 90 years of 3.5 to 4 degrees Celsius and decreases in precipitation of 5 to 20 percent. These changes have potential to profoundly affect plant and animal distributions and population viability. Furthermore, more than 70 percent of the lands in the southwestern U.S. are in public ownership. Managers of public lands and wildlife resources will have a particular need to understand climate-driven shifts in order to adapt management strategies to conserve and sustain habitats and wildlife.

The three-year, $1.6-million project will be staffed by scientists from USGS, Northern Arizona University, and Purdue University. It will integrate results from three modules to produce data and tools conservation managers can utilize in decision making. The first module focuses on the refinement and testing of models that have already been developed to project the effects of climate change on individual plant species distributions. These models employ a statistical methodology called downscaling to apply data from global climate model (GCM) results to local species. The models will be expanded to include additional plant species and tested through hindcasting, a process that applies models to recent climate changes to determine which ones would have most accurately predicted those changes.

The project's second module emphasizes partner engagement to prioritize wildlife management needs and efficient technology transfer. Project scientists will work with management and conservation partners through a workshop, a survey, and the establishment of a partner advisory team in order to prioritize wildlife species for study. The advisory team will also provide input on data sharing and the creation of useful tools for managers, such as a user-friendly website for downloading downscaled GCM data.

Finally, the third module will apply the results from the first two to forecast the effects of climate change on targeted wildlife species. For example, scientists will examine the ranges of plant species that are closely linked ecologically to specific animal species. Modeling the impact of climate changes on these ranges will enable prediction of the effects of the changes upon dependent animal species. Differences in mobility, temperature sensitivity, and specific habitat requirements among targeted animal species will be taken into account as well.

As a whole, the project's three modules will enable scientists to assess the future prospects of the habitats and species most vulnerable to climate change within the study area. This information is vital to managers tasked with prioritizing conservation efforts and adapting strategies to sustain

habitats and wildlife species. The development of realistic landscape-scale models tailored to those species will provide managers with practical, data-informed tools they can utilize in decision making.

Personnel

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Many species of the arid Southwest are particularly sensitive to climate change. This Joshua tree woodland in Mojave County, Arizona, photographed in April 2004, shows mortality resulting from several years of hot-dry climate. During 2003, this area received only 17% of its typical annual precipitation, and the average annual temperature was 2.2 degrees Celsius warmer than the long-term mean.

Modeling of climate changes has enabled scientists to predict their impact on Joshua tree populations, as shown on this map. Red areas indicate existing populations with future climates unsuitable for Joshua tree survival, while orange shows current populations with future climates favorable for survival. The species may migrate naturally into and survive within the yellow areas. Green areas are predicted to have a suitable climate, but migration into these habitats will require human intervention.